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Reflector

[What is claimed is:]

(1) A reflector with a mirror surface, being characterized in that a transparent photocatalytic layer is formed on a top layer of said mirror surface.

(2) The reflector according to claim 1, wherein said transparent photocatalytic layer is comprised of any one selected from a group of TiO_2, Fe_2O_3, In_2O_3, and WO_3.

(3) The reflector according to claim 1 or 2, wherein the photocatalytic layer contains at least one of metals selected from a group of Pt, Pd, Rh and Ir.

[Detailed Description of the Invention]

[Technical Field]

The present invention relates to a high-efficiency reflector for use in lighting instruments, such as an incandescent lamp, a halogen lamp, a mercury lamp, etc.

[Background Art]

A reflector is used for the purpose of improving the irradiation efficiency of the lighting instruments, such as an incandescent lamp, a halogen lamp, a mercury lamp, etc.

In such a reflector, a mirror surface is made, for example, by polishing a metal base with chemical polishing, electrolytic polishing, airplane-cloth polishing, etc. Also, such a reflector is manufactured by forming a transparent protection coating film 6 of Alumilite, a transparent paint film, or a metal oxide film, etc. on a mirror surface which is obtained by forming a bright metal film 4 of Al, Ag or the like, directly on the surface of a base 3 of metal, plastic, glass, ceramic, etc., or indirectly through a undercoat layer of an organic paint coating film or the like, as shown in FIG. 3.

Such a reflector 1' is excellent in reflectivity just after it is manufactured. It shows, for example, reflectivity of 80-96% in a visible region (380-780 nm).

However, after it is used for a long period of time, suspended materials in the ambient atmosphere (mainly, organic materials) adhere to the surface of the reflector 1', whereby its reflectivity is deteriorated. For example, after being used for one year or so, the reflectivity can become deteriorated by 20-50%, depending upon the condition of use. Thus, in the case of using the reflector 1', it is necessary to clean the surface thereof. However, since organic materials or other dirt or the like are adhered to the surface of the reflector by heat of a lamp, removal of these materials can not be carried

out so easily.

[Purpose of the Invention]

The present invention takes the drawback mentioned above into consideration and aims at providing a reflector which can maintain an original high reflectivity for a long period of time.

[Disclosure of the Invention]

For achieving the purpose mentioned above, according to the present invention, there is provided a reflector having a mirror surface, being characterized in that a transparent photocatalytic layer is formed on a top layer of said mirror surface.

Hereinafter, a detailed explanation will be given of the present invention with reference to the drawings.

As shown in FIG. 1, a reflector 1 according to the present invention is used in a condition of being provided behind a light source 2 such as an incandescent lamp, a halogen lamp, a mercury lamp, etc.

In this embodiment, as shown in FIG. 2, a bright metal film 4 of Al, Ag or the like is formed directly on the surface of a base 3, or indirectly through a undercoat layer of an organic paint coating film or the like, and thereby a mirror surface 5 is formed.

As a material of the base 3, metal, plastic, glass, ceramic or the like can be used. However, it should not be limited to these. Also, the mirror surface 5 may be formed by chemical polishing, electrolytic polishing, airplane-cloth polishing, etc.

On the surface of the mirror surface 5 formed in the manner mentioned above, a protection coating film 6 which is the same as the conventional art may be formed, if necessary.

As a material of the protection coating film 6, an oxide film of Alumite or the like may be used, which is formed through oxidation of the surface thereof in the case where the mirror surface 5 is formed by polishing the metal base surface. Also, a transparent paint film of organic paint etc. or a metal oxide film formed by conducting vacuum evaporation to SiO_2, Al_2O_3, CeO_2, MgF_2 etc. may be used in the case where the mirror surface 5 is made by forming a bright metal oxide film 4 on the surface of the base 3. However, it should not be limited to these.

A transparent photocatalytic layer 7 is formed on the top layer of the mirror surface 5 through the protection coating film 6 or directly without the protection coating film 6, and thereby a reflector 1 according to the present invention is obtained.

As a material of the photocatalytic layer 7, at least one chemical compound selected from a group of TiO_2, Fe_2O_3, In_2O_3, and WO_3 can be listed. As a method for forming the photocatalytic layer from such a chemical compound, although it should not

be limited in the present invention, the following method can be applied:

a vacuum process such as a vacuum evaporation method using resistance heating, a sputtering method, an electron beam evaporation method using an electron gun, an ion plating method, or the like;

a method in which a solution of an organometallic compound including metal from among the above-mentioned chemical compounds (i.e., Ti, Fe, In, W, etc.) is applied onto the mirror surface 5, dried, and baked at a high temperature; and

a method in which fine particle powder of the above-mentioned chemical compound is dispersed into transparent paint, applied onto the mirror surface 5, and dried, so as to form a paint film.

However, with respect to the last-mentioned method, in which fine particle powder is dispersed into transparent paint and thereby a paint film is formed, it is preferable that the fine particle powder to be dispersed has a particle diameter of 0.1 µm or less, and that an addition amount thereof with respect to the transparent paint is in the range of 10 to 20%. If the diameter of the fine particle powder exceeds 0.1 µm, the shielding effect due to the fine particle powder is so strong that the transparency of the paint film may be deteriorated. Also, if the addition amount is less than 10%, the effect of the addition is not sufficient. If the addition amount exceeds 20%, the transparency of the paint film may be deteriorated.

The film thickness of the photocatalytic layer 7, which is formed by such a method as mentioned above, is preferably determined to be within or near the range from 0.5 to 5 µm. However, it should not be limited to any particular thickness. If the film thickness is less than 0.5 µm, the photocatalytic effect is not sufficient. If the film thickness exceeds 5 µm, there is a good likelihood that the transparency will be remarkably deteriorated. In this case, even if the transparency is not deteriorated, the photocatalytic effect achieved thereby is not so different from the case of the thickness being less than 5 µm.

For the photocatalytic layer 7 mentioned above, it is also possible to carry or contain further at least one metal selected from among a group including Pt, Pd, Rh and Ir. Such metals function as a catalyst to decompose the attached dirt. By allowing the photocatalytic layer 7 to carry such metal, it is possible to thereby further improve the function of removing dirt or contaminants.

As a method for allowing the photocatalytic layer 7 to carry such metal, although it should not be limited in this invnetion, a method comprising the following steps can be applied:

preparing an aqueous solution of soluble salt of the above-mentioned metal;

immersing the reflector 1 on which the above-mentioned photocatalytic layer 7 is formed into the solution and thereby allowing the soluble salt to soak into the photocatalytic layer 7;

thereafter irradiating ultraviolet rays or the like thereupon, decomposing the soluble salt, and thereby causing the photocatalytic layer 7 to carry the above-mentioned metal.

Further, with respect to the amount of the metal carried on the photocatalytic layer 7, although it should not be limited to a particular amount, it is preferable to carry 0.1 - 2% of the metal with respect to the photocatalytic layer 7. If the amount is less than 0.1%, the effect of carrying the metal is not sufficient. If it exceeds 2%, there is a good likelihood that the transparency of the photocatalytic layer may be deteriorated.

As mentioned above, if suspended materials in the ambient atmosphere adhere as dirt to the reflector 1 according to the present invention on which the photocatalytic layer 7 is formed on the top layer thereof, the adhering materials can be decomposed and removed by the function of the metal oxide such as TiO_2, Fe_2O_3, In_2O_3, WO_3, or the like within the above-mentioned photocatalytic layer 7, and by the metal such as Pt, Pd, Rh, Ir, or the like through the ultraviolet-ray radiation from the light source. Accordingly, such dirt will not remain on the surface of the photocatalytic layer 7 and it is possible to keep the reflector surface clean.

Next, explanations will be given of embodiments of the present invention, as well as a comparative example.

(Embodiment 1)

The surface of an aluminum base plate which is formed in a desired shape through a method such as press, spinning, or the like is degreased, thereafter immersed for 120 seconds in chemical polishing liquid which contains phosphoric acid of 72.3 mass %, nitric acid of 6.9 mass %, water of 18.9 mass %, and aluminum phosphate of 1.9 mass %, and is heated to be 100 °C, and thereby the surface is polished. Next, the aluminum base plate is fully cleaned with water and dried, thereby a mirror surface is obtained. Transparent paint of a silicon group, which is obtained by adding 10% of fine particle powder of titanium oxide (particle diameter: 0.08 μm), is applied to the mirror surface through a spray method, and baked at a temperature of 220-250 °C for 20 minutes, whereby a reflector, on which a transparent photocatalytic layer having a thickness of 3-5 μm is formed, is obtained. The reflector has a mean reflectivity of 85% for visible light (380-780 nm). When such a reflector is used, for example, as a lighting instrument for a high ceiling using a mercury lamp, hardly any dirt adheres to the surface thereof, and also the mean reflectivity thereof remains almost the same as its

original value even after the instrument is operated for 10,000 hours.

(Embodiment 2)

On the surface of a hard glass base formed into a parabolic shape by press forming, a bright aluminum film having a thickness of 700-1,000 Å is formed by a resistance heating evaporation method under a vacuum condition of $1\times10^{-5} - 1\times10^{-4}$ Torr. Next, on the bright aluminum film a transparent protection coating film of silicon dioxide having a thickness of 4,000-7,000 Å is formed through an electron beam evaporation method under a vacuum condition of 1×10^{-5} - 5×10^{-5} Torr. Next, a photocatalytic layer made of titanium oxide having a thickness of 1.0 – 1.2 μm is formed on the transparent protection coating film through an electron evaporation method, and thereby a reflector is obtained. The reflector has a mean reflectivity of 90% for visible light. When such a reflector is used as a spotlight of a mini halogen lamp, hardly any dirt adheres to the surface thereof, and also the mean reflectivity thereof remains almost the same as its original value even after the instrument is operated for 10,000 hours.

(Embodiment 3)

A hard glass base on which a bright aluminum film and a transparent protection coating film of silicon dioxide are formed in the same manner as in Embodiment 2 is repetitively immersed in a 5% ethanol solution of tetraisopropoxy titanium ($Ti(O\text{-}iC_3H_7)_4$) and dried, thereafter is baked at a temperature of 500 °C for 30 minutes, and thereby a reflector, on which a photocatalytic layer of titanium oxide is formed, is obtained. The photocatalytic layer has a film thickness of 1.0 μm. Next, the reflector is immersed in an aqueous solution of platinum chloride, ultraviolet rays are irradiated on the reflector, and thereby the photocatalytic layer is caused to carry platinum. The amount of platinum carried with respect to the photocatalytic layer is 1%. The reflector obtained in this manner has a mean reflectivity of 90% for visible light. When such a reflector is used for a spotlight of a mini halogen lamp, hardly any dirt adheres to the surface thereof, and also the mean reflectivity thereof remains almost the same as its original value even after the instrument is operated for 10,000 hours.

(Comparative example 1)

A reflector is manufactured in the same manner as in Embodiments 2 and 3, except that no photocatalytic layer is formed on the top layer thereof. The reflectivity of the reflector obtained is 90% for visible light just after the manufacturing thereof. When such a reflector is used for a spotlight of a mini halogen lamp, dirt in a considerable amount attaches to the surface thereof, and the mean reflectivity thereof is decreased to 78% after the instrument is operated for 10,000 hours.

(Embodiment 4)

On a hard glass base on which a bright aluminum film and a transparent protection coating film of silicon dioxide are formed in the same manner as in Embodiment 2, a photocatalytic layer of indium oxide having a thickness of 1.0-1.2 μm is formed by an electron beam evaporation method under a vacuum condition of 1×10^{-5} -1×10^{-4} Torr, and thereby a reflector is obtained. The reflector has a mean reflectivity of 88% for visible light. When such a reflector is used for a spotlight of a mini halogen lamp, hardly any dirt adheres to the surface thereof, and also the mean reflectivity thereof remains almost the same as its original value even after the instrument is operated for 10,000 hours.

(Embodiment 5)

The reflector obtained in Embodiment 4 is immersed in an aqueous solution of palladium chloride and dried. Next, ultraviolet rays are irradiated thereupon, and thereby the photocatalytic layer is allowed to carry 0.5% of palladium. The reflector has a mean reflectivity of 88% for visible light. When such a reflector is used for a spotlight of a mini halogen lamp, hardly any dirt adheres to the surface thereof, and also the mean reflectivity thereof remains almost the same as its original value even after the instrument is operated for 10,000 hours

[Effect of the Invention]

A reflector according to the present invention has such a structure as mentioned above. Since a transparent photocatalytic layer is formed on the top layer on the mirror surface, it is possible to maintain the original high reflectivity thereof for a long period of time.

【Brief Description of Drawings】

FIG. 1 is a view for explaining the structure in a case of applying the reflector according to the present invention to a lighting instrument; FIG. 2 is a view for explaining the structure of a embodiment according to the present invention; and FIG. 3 is a view for explaining the structure in a case of applying the reflector according to the conventional art to a lighting instrument.

1...reflector 5...mirror surface 7...photocatalytic layer

FIG. 1

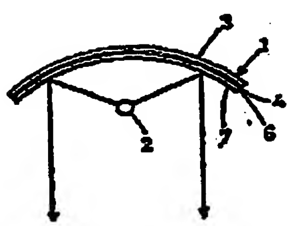


FIG. 3

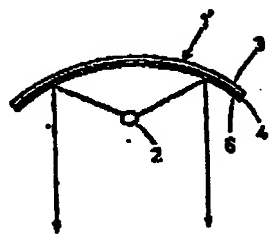
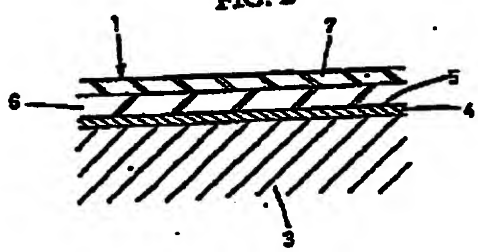


FIG. 2



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ACCESSION NUMBER: 1988-046924 [07] WPINDEX
DOC. NO. NON-CPI: N1988-035345
DOC. NO. CPI: C1988-020964
TITLE: Reflecting mirror - has transparent photo-catalyst layer based on titanium oxide, ferric oxide, indium oxide and/or tungsten oxide.
DERWENT CLASS: L02 M13 P81
PATENT ASSIGNEE(S): (MATW) MATSUSHITA ELECTRIC WORKS LTD
COUNTRY COUNT: 1
PATENT INFORMATION:

PATENT NO	KIND	DATE	WEEK	LA	PG	MAIN IPC	
JP 63005301	A	19880111	(198807)*		4		<--

APPLICATION DETAILS:

PATENT NO	KIND	APPLICATION	DATE
JP 63005301	A	JP 1986-149016	19860625

PRIORITY APPLN. INFO: JP 1986-149016 19860625
INT. PATENT CLASSIF.: G02B005-08
BASIC ABSTRACT:

JP 63005301 A UPAB: 19930923
A reflecting mirror has a mirror surface, and a transparent photocatalyst layer is formed as the uppermost layer of the mirror surface. The

photocatalyst layer is at least one of TiO_2, Fe_2O_3, In_2O_3 and WO_3. At least one of Pt, Pd, Rh and Ir is held in the photocatalyst layer.

The photocatalyst layer can be obtd. by vacuum evapn. by resisting heating, sputtering, electron beam evapn., and vacuum process such as ion plating, etc. of at least one cpd of TiO_2, Fe_2O_3, In_2O_3 and WO_3. The organic metal cpd soln including metal (Ti, Fe, In, W, etc) in the cpd is applied onto the mirror surface, then dried, and burned at high temp. Alternatively fine particle powder of the cpd is dispersed and mixed into the transparent coating material, to be applied onto the mirror surface.

USE/ADVANTAGE - The high reflectivity at the initial time can be kept for a long period by forming transparent photocatalyst layer as the uppermost layer of the mirror surface.

FILE SEGMENT: CPI GMPI
FIELD AVAILABILITY: AB
MANUAL CODES: CPI: L02-G10; L02-J01; M13-H